

Case report

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CONTEMPORARY APPROACH OF COMPLEX ACUTE ISCHEMIC STROKE LESIONS: A CASE REPORT WITH
LITERATURE REVIEW

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Acute ischemic stroke caused by tandem occlusions represents one of the most challenging conditions in endovascular stroke treatment. Recent advances in imaging-based patient selection have expanded the therapeutic window for mechanical thrombectomy and improved clinical outcomes in selected patients. We present the case of a patient with acute ischemic stroke due to tandem occlusion of the internal carotid and middle cerebral artery, treated successfully 12 hours after symptom onset using an antegrade (proximal-to-distal) endovascular approach. Proximal aspiration enabled differentiation between atherosclerotic disease and arterial dissection before carotid stenting, facilitating procedural planning and successful intracranial recanalisation. The case is discussed in the context of current

evidence regarding patient selection and endovascular strategies for tandem lesions. Although both antegrade and retrograde approaches are currently used, treatment should be individualised according to lesion characteristics, collateral circulation, and procedural considerations.

Keywords: acute ischemic stroke; tandem occlusion; endovascular treatment

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Prikaz slučaja

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SAVREMENI PRISTUP LEČENJU TANDEMSKIH LEZIJA KOD AKUTNOG ISHEMIJSKOG MOŽDANOG
UDARA: PRIKAZ SLUČAJA SA PREGLEDOM LITERATURE

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Akutni ishemijski moždani udar izazvan tandemskim lezijama predstavlja jedan od najvećih izazova u endovaskularnom lečenju moždanog udara. Savremeni pristup zasnovan na naprednim metodama snimanja omogućio je proširenje terapijskog prozora za mehaničku trombektomiju i poboljšanje ishoda kod pažljivo odabranih bolesnika. Prikazan je slučaj pacijenta sa akutnim ishemijskim moždanim udarom usled tandemske okluzije unutrašnje karotidne i srednje moždane arterije, uspešno lečenog 12 sati nakon početka simptoma primenom antegradnog (proksimalno-distalnog) endovaskularnog pristupa. Proksimalna aspiracija omogućila je razlikovanje aterosklerotske lezije od disekcije pre postavljanja karotidnog stenta, čime je olakšano planiranje intervencije i postignuta uspešna intrakranijalna

rekanalizacija. Prikaz slučaja razmatran je u svetlu savremenih saznanja o izboru bolesnika i strategijama endovaskularnog lečenja tandemskih lezija.

Ključne reči: akutni ishemijski moždani udar; tandemska okluzija; endovaskularno lečenje

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Introduction

Since acute ischemic stroke (AIS) is a time critical emergency condition associated with high mortality and disability rates, the application of an adequate and timely treatment is of crucial, both medical and socioeconomic, importance. It is well known that a delay of endovascular treatment decreases the rates of favourable clinical outcome in patients, since there is an irreversible damage in the large number of neurons (1). Previous studies have demonstrated that in acute ischemic stroke patients' with occlusion of the proximal segments of the large cerebral arteries or the internal carotid artery (ICA) occlusion endovascular thrombectomy (ET) is the most effective treatment within the first 6 hours (2,3). Current guidelines also recommend ET in carefully selected patients up to 24 hours after symptom onset based on advanced imaging findings (1).

Literature review

Extension of therapeutic time window

The results of the latest studies have indicated new trends in treatment. A DEFUSE 3 study (*Endovascular Therapy Following Imaging Evaluation for Ischemic Stroke 3*) (2) has shown a 28% increase in functional independence as well as 20% absolute reduction in death or severe disability, in randomized patients at a median of 11 hours from onset. Such results have demonstrated the largest decline in deaths and severe disability ever recorded. In addition, another study DAWN (3) (*DWI or CTP Assessment With Clinical Mismatch in the Triage of Wake-Up and Late Presenting Strokes Undergoing Neurointervention With Trevo*) that included randomized patients at a median of 12.5 hours from onset has reported a 35.5% absolute increase in functional independence, which is the highest rate demonstrated in acute stroke treatment trials.

The explanation of the results of these studies lies in the mechanism of the occurrence of this pathophysiological disorder (2,3). An MRI or CT perfusion examination gives us an insight into the size of a definite ischemic area, infarct core and potentially reversible tissue-penumbra, which is crucial for the evaluation of the further outcome. In certain patients a large area of diffusion restriction may appear within a few hours, whereas in others this area may either grow gradually or not change at all, primarily depending on the degree of collateral development (4). The presence of collaterals and penumbra are crucial for the success of the applied ET regardless of the time of the onset of symptoms (2,3). These

concepts have subsequently been incorporated into international stroke guidelines and now represent the basis for patient selection in the extended treatment window (1).

According to the DAWN trial, compared to the patients receiving solely standard medical care, in cases of the application of thrombectomy combined with standard medical care, the rates of outcomes for disability and functional independence at 90 days were higher, in patients with stroke caused by the intracranial ICA or proximal middle cerebral artery (MCA) occlusion, having an evident mismatch between the severity of the clinical deficit and the infarct volume, who had last been known to be well 6 to 24 hours prior to stroke (3).

ET is currently recommended for eligible patients both within the first 6 hours and in carefully selected patients up to 24 hours after symptom onset based on advanced imaging criteria (1). However, similarities were found between the rate reported in a pooled analysis of five trials of thrombectomy and the rate of functional independence, and the safety profile for thrombectomy performed 6 to 24 hours after the stroke onset in the thrombectomy group in DAWN trial. Moreover, no significant difference was found between mortality rates and symptomatic intracerebral hemorrhage (ICH) in comparison to the rates in patients receiving standard medical care within 6 hours following the onset of stroke (3).

A prompt revascularization of brain-tissue at-risk which may be salvageable is of critical importance in the management of the AIS (1,4). This tissue may be viable during a certain period of time due to collateral perfusion. Therefore, the purpose of imaging in AIS is the detection of affected brain parenchyma and identification of regions containing potentially salvageable tissue in order to perform prompt intervention and reperfusion (4).

Rapid multi-modal imaging is crucial for the identification of patients for whom the ET may be the most favorable, since intravenous (IV) tissue plasminogen activator (tPA) alone is generally better for reperfusion of small distal vessel occlusions than large proximal occlusions (1,4). Current guidelines recommend tissue-based rather than time-based selection of patients presenting in the extended treatment window (1).

Recent major stroke trials have involved the use of various rapid imaging techniques (4). Magnetic resonance imaging (MRI) with perfusion weighted imaging (PWI) has been used for the identification of

patients who would benefit most from receiving ET up to 6-24 hours after the onset of stroke symptoms (2,3). Furthermore, the application of MRI aimed at identification of patients eligible for thrombolysis in cases of unknown symptom onset is also a significant research area (5).

Tandem occlusion stroke

Acute tandem occlusion including the extracranial ICA with concomitant intracranial thromboembolism to the intracranial ICA terminus or MCA is present in approximately in 15-20 % of all cases of large-vessel AIS, caused primarily by atherosclerosis or dissection or less commonly by cardioembolism or undetermined etiology (6,7). The endovascular management of these lesions is challenging and their response to IV tPA is poor, most likely due to a poor response to fibrinolysis and the high clot burden associated with them (6,8). Compared to an intracranial lesion alone, the prognosis for tandem lesions is commonly worse and is associated with a higher rate of 90-day mortality, as well as higher rates of symptomatic ICH. In patients with anterior circulation AIS, tandem lesions represent the worst-case scenarios causing severe neurologic morbidity and death rate of up to 70% (6).

The issue of whether to treat extracranial or intracranial lesion first is still controversial (9).

Several various endovascular treatments have been proposed, such as mechanical thrombectomy alone without the treatment of the extracranial ICA; the treatment of the cervical lesion with stenting or angioplasty first and distal thrombectomy afterwards; as well as distal mechanical thrombectomy first, followed by the treatment of the cervical lesion (9–11).

It is a matter of debate which interventional strategy is the best for management of the tandem lesions (8,9).

The advantage of distal ET first is decreasing time to recanalization of the intracranial vessel which reduces the duration of ischemia if there are adequate intracranial collaterals (9,11). On the other hand, primary stenting improves intracranial collaterals during the performance of recanalization (9).

There are two important issues regarding the treatment of tandem lesions: which of the lesions to treat first and whether or not a stent should be placed in the extracranial carotid lesion. The purpose of immediate stenting is securing the ICA patency (9). However, in order to reduce the risk of stent thrombosis, the patient receives a loading dose of dual antiplatelet which if applied in the acute phase

of a AIS causes a greater risk of ICH, particularly in case of a large stroke (National Institute of Health Stroke Scale- NIHSS 21) with baseline parenchymal ischemic damage (ASPECTS 8). Moreover, it is well known that in the first 24 hours there is a contraindication of even single-antiplatelet therapy to an IV tPA the patients has received. Consequently, a rate of up to 20% of ICH has been reported following acute stenting in patients with AIS presenting with tandem occlusions (12,13).

Predominantly used endovascular strategy in the past was the “proximal-to-distal” approach (the so-called antegrade approach). The method involves stepwise treatment of the arterial occlusion, whereas the extracranial internal carotid lesion is treated first and the intracranial occlusion afterwards (9,10).

Multicentric Experience in Distal-to-Proximal Revascularization of Tandem Occlusion Stroke Related to Internal Carotid Artery Dissection (11) is the first multicenter study conducted to assess a different approach, the “distal-to-proximal” approach, in which the intracranial occlusion is treated first for the purpose of restoring cerebral blood flow quickly in cases of tandem occlusion related to the internal carotid dissection.

However, there are certain drawbacks to this approach (9). First, a patient undergoing angioplasty and stenting of the proximal lesion after recanalization of the distal lesion is exposed to risk of distal emboli leading to a post-treatment intracranial re-occlusion. Therefore, a repeat thrombectomy is required (9,11). Second, untreated lesion of the proximal segment of the ICA may cause a problem for the distal passage and the adequate placement of the devices, i.e., for the guiding catheters required for distal thrombectomy (9,10).

Although the overall results of proximal to distal approach are satisfactory there is still a possibilities for improvement (10). Cerebral hypoperfusion is significantly prolonged due to the treatment of the cervical lesion with stent placement (9,11). There is a possibility of extensive dissection because it may be complicated to place the cervical carotid stent in a dissected vessel (11). A larger infarct core volumes may be caused due to a prolonged duration of brain ischemia since recanalization is performed as the second step (9,11).

Endovascular treatment approaches for tandem occlusions remain a matter of debate. Certain recent multicenter randomized trials have even excluded patients with tandem occlusions (8,9). Furthermore, tandem occlusion stroke is typically analyzed by pooling atheromatous and internal carotid dissection etiologies (6), emphasizing the need for an individualized treatment strategy.

Case report

We will present a case of a patient who was hospitalized 12 hours after the onset of symptoms: left-sided dissociated hemiparesis (plegic arm, severely paretic leg) as well as paresis of mimic muscles of central type on the left. On hospital admission the patient's blood pressure was 140/70 mmHg. After a neurological examination, the patient was referred to an urgent brain MRI according to ischemia protocol. The aim of this examination was to detect predictive factors and evaluates the possibility of endovascular treatment. An MRI scan of 13 minutes included DWI, FLAIR, SWAN, TOF angiography, as well as the non-contrast 3DASL perfusion sequence. These sequences enable the confirmation of the ischemic stroke diagnosis with precise location, as well as an approximate evaluation of the stroke date, detection of potential reversible tissue, occluded arteries detection, locating the thrombus and ruling out hemorrhage or other mimic lesions.

The DWI sequence clearly showed the presence of an area of diffusion restriction in the right MCA irrigation area- ASPECTS score 6, with low values on the ADC map. On FLAIR sequence, the ischemic area was demarcated predominantly in cortical and subcortical areas, indicating chronicity, with linear parietal cortical hyperintense signals, which were in favour of leptomeningeal collaterals. TOF-MRA detected no signal within right ICA and in the right MCA. SWAN sequence revealed the presence of thrombus in the M1 segment of the right MCA, which also propagated in the M2 segment of the artery. In addition, a brush sign was seen on SWAN. A non-contrast 3DASL perfusion sequence showed decreased perfusion in the entire right cerebral hemisphere, with CBF values of about 17 ml / 100 g / min (Figure 1).

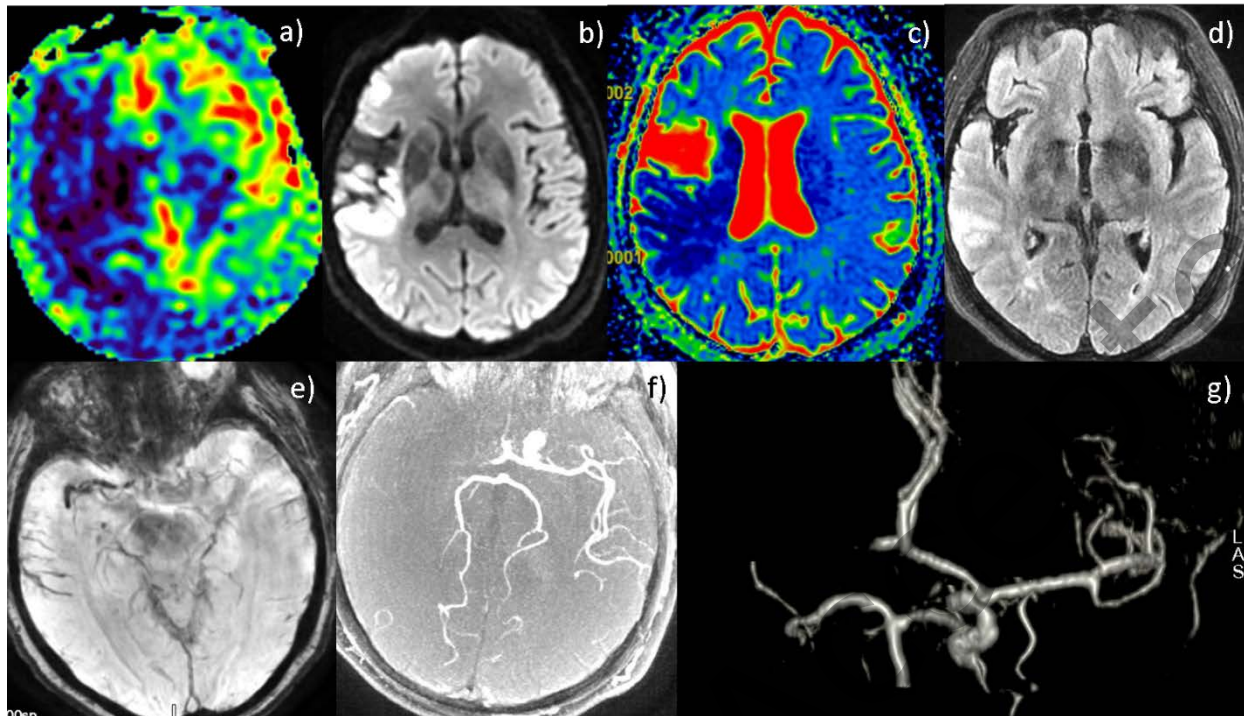


Figure 1. Preprocedural MRI. a) 3D-ASL perfusion map demonstrating markedly reduced perfusion throughout the right cerebral hemisphere. b) DWI showing restricted diffusion in the right middle cerebral artery territory. c) ADC map demonstrating corresponding low ADC values. d) FLAIR image showing predominantly cortical and subcortical hyperintensity within the ischemic territory. e) SWAN image demonstrating the susceptibility vessel sign in the M1 segment of the right middle cerebral artery with the brush sign. f) Axial TOF-MRA and g) three-dimensional TOF-MRA reconstruction demonstrating absent flow-related signal in the right middle cerebral artery. MRI - magnetic resonance imaging; 3D-ASL - three-dimensional arterial spin labeling; ADC - apparent diffusion coefficient; DWI - diffusion-weighted imaging; FLAIR - fluid-attenuated inversion recovery; SWAN - susceptibility-weighted angiography; TOF-MRA - time-of-flight magnetic resonance angiography.

Immediately after the diagnostics, the patient was transferred to the angiography operating room and femoral puncture was performed an hour after the patient's admission.

Diagnostic angiography confirmed the presence of an occlusion of right ICA, and right MCA from the origin, i.e. a tandem lesion. Our strategy in the treatment of such lesions that gives positive results is a

proximal to distal approach, using aspiration technique proximally to differentiate the underlying lesion, in order to distinguish the dissection from atherosclerosis. After giving intravenous analgesia, we first positioned the guiding catheter into the right CCA, and over it the aspiration catheter along the occlusion site. Following several aspirations, the control angiogram showed a minimum flow through the right ICA, with persistent high-density lesion on the bulbous and the origin of the right ICA. We decided to place a self-expanding stent without the use of distal protection, since we also had carotid T occlusion. Therefore, there was no possibility of the distal embolization, which shortens the duration of the entire reperfusion procedure. Following the stent implantation, a control angiogram revealed incomplete expansion. Hence, we performed post-dilatation, thus receiving an excellent result afterwards. Avoiding the passage of a stent through a stent, the aspiration system was used for distal thrombectomy. After penetrating through the thrombus with a wire and passing through by a microcatheter, we confirmed to be in the right blood vessel and we performed three aspirations. A control angiogram showed satisfactory TICI 2b / 3 recanalization forty minutes after the puncture (Figure 2). According to our protocol, and in order to exclude potential complications, such as bleeding, immediately after completing the intervention, we performed a control Dyna CT in the angiography suite, which showed no post-interventional bleeding (Figure 3). A control MR examination was performed the following day according to the protocol for ischemia, showing the right ICA and MCA recanalization, accompanied by luxury perfusion on 3DASL (Figure 4). Prior to stent placement, the patient received 250 mg of Cardipirin and 180 mg of Clopidogrel. Since the control MR examination did not show the presence of hematoma, the patient continued with double antiaggregation therapy.

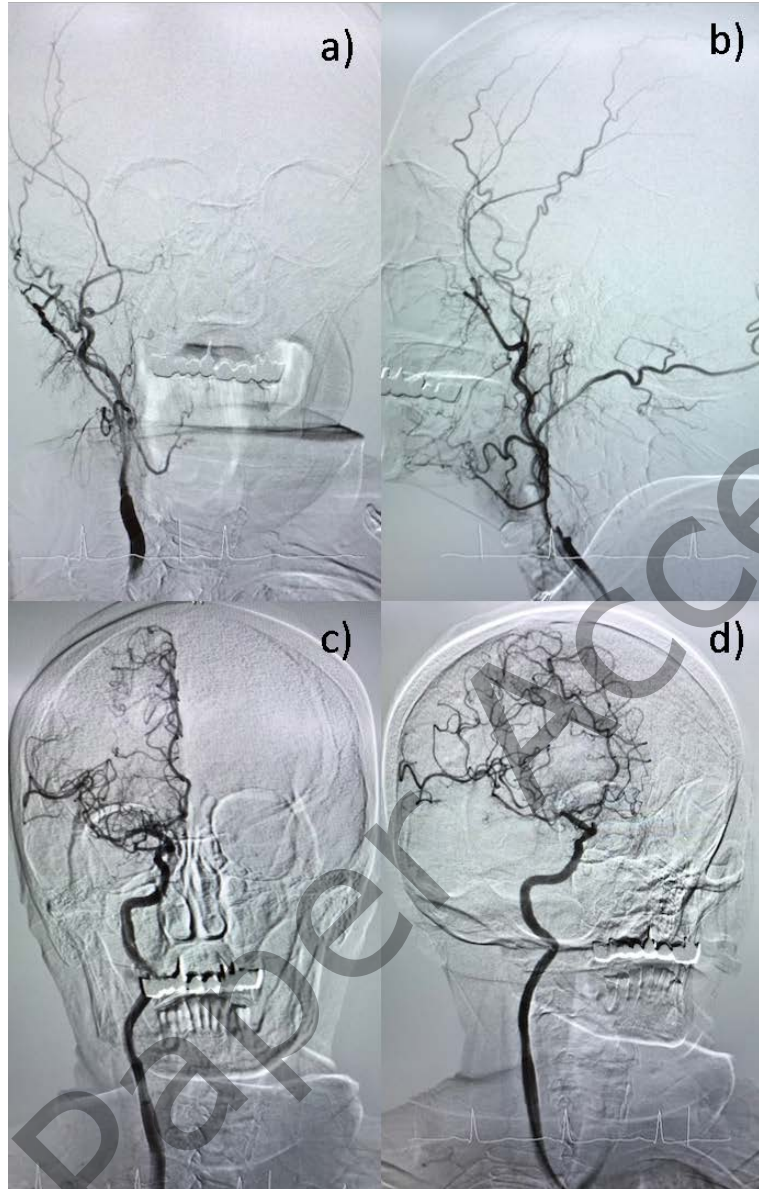


Figure 2. DSA during endovascular treatment. a) Anteroposterior and b) lateral projections of the initial DSA demonstrating tandem occlusion of the right internal carotid artery and the right middle cerebral artery. c) Anteroposterior and d) lateral projections of the final DSA following carotid stenting and aspiration thrombectomy, demonstrating successful reperfusion (TICI 2b/3). DSA - digital subtraction angiography; TICI - Thrombolysis in Cerebral Infarction



Figure 3. Postprocedural Dyna CT and retrieved thrombus. a) Postprocedural Dyna CT demonstrating no evidence of procedure-related complications, including intracranial hemorrhage. b) Gross appearance of the thrombus retrieved after aspiration thrombectomy following three aspiration passes. CT - computed tomography

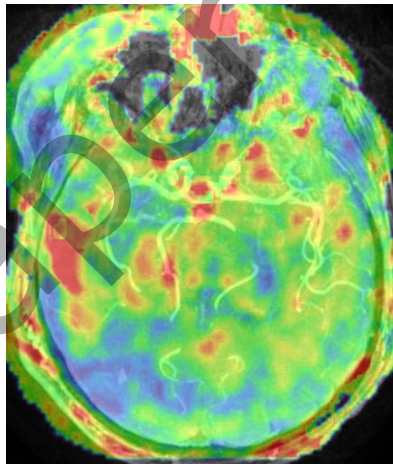


Figure 4. Follow-up MRI. Fused 3D-ASL perfusion and TOF-MRA images demonstrating luxury perfusion in the right cerebral hemisphere following successful reperfusion. MRI - magnetic resonance imaging; 3D-ASL - three-dimensional arterial spin labeling; TOF-MRA - time-of-flight magnetic resonance angiography.

Immediately after the intervention there was a gradual withdrawal of the symptoms. Left-sided dissociated hemiparesis was present at the hospital discharge.

Discussion

Although both proximal-to-distal and retrograde distal-to-proximal approaches are currently used, increasing evidence from observational studies suggests that the retrograde approach may shorten the time to intracranial reperfusion and improve procedural efficiency in selected patients. Nevertheless, no consensus has been reached regarding the optimal strategy, and the choice of technique should be individualized according to vascular anatomy, etiology of the cervical lesion, collateral circulation, and operator experience (9,14).

A paradox is that compared to the outcomes of thrombectomy in many trials with patients treated within 6 hours following the onset of stroke, in the DEFUSE 3 trial thrombectomy outcomes were better (2,15). The reason for obtaining such result may be explained by the fact that patients with favorable collateral circulation and slower infarct growth were selected for the trial (2).

Contrary to the DAWN trial which used the selection criteria of a mismatch between the severity of the clinical deficit and the early infarct size on imaging (3), the patients included in DEFUSE 3 trial were with larger core infarctions than the patients in the DAWN trial (2,15). In addition, DEFUSE 3 trial enrolled patients with milder stroke symptoms. Due to the above mentioned differences, a broader patient population was included in the DEFUSE 3 trial than in the DAWN trial. The selection criteria required for the DAWN would not have been fulfilled by about 40% of the patients in the DEFUSE 3. However, this study found a similarity in the efficacy of ET between the patients who fulfilled the selection criteria used in the DAWN trial and those who did not fulfill such criteria. The result of the application of ET within 6 to 16 hours following the onset of stroke combined with standard medical therapy in patients with acute ischemic stroke caused by large-vessel occlusion and with favorable PWI findings was a lower disability rate and a higher rate of functional independence at 3 months in comparison to patients who received only the standard medical therapy (2).

In the present case, an antegrade (proximal-to-distal) strategy was deliberately selected. Initial aspiration of the cervical ICA lesion enabled differentiation between underlying atherosclerotic disease and arterial dissection, which was considered essential before proceeding with intracranial

thrombectomy. Furthermore, restoration of proximal carotid patency facilitated stable distal access and provided improved cerebral perfusion through collateral circulation before intracranial recanalization. In the setting of carotid T occlusion, distal embolization during carotid stenting was considered less likely, allowing carotid stenting without distal embolic protection and minimizing procedural delay. This strategy resulted in successful reperfusion (TICI 2b/3) with favorable clinical recovery.

The proximal to distal approach has many benefits because it allows a more secure and safer procedure (10,16). The treatment of proximal lesion first does not require the use of a distal protection the setting of which would further extend the duration of the procedure, since the possible emboli from the lesion would be stopped by the distal carotid T occlusion lesion (10). However, if only the MCA is occluded, whereas anterior cerebral artery (ACA) shows good patency, the use of distal protection is necessary (9). Furthermore, after ICA recanalization, the distal flow improves and the collaterals that maintain the tissue viable for certain time are better (10,13). In addition, there are cases followed by complete distal recanalization after the setting of a proximal flow (13).

Proximal aspiration was first performed to clarify the underlying pathology of the cervical ICA occlusion. This step provided valuable information regarding the lesion etiology and allowed a more informed decision regarding carotid stent implantation before proceeding with intracranial thrombectomy.

Our experience is consistent with previous reports suggesting that no single endovascular strategy is universally superior for tandem occlusions (9,14). Instead, procedural planning should be individualized according to lesion etiology, collateral circulation, vascular anatomy, and technical considerations. For this patient, starting with proximal aspiration helped us better understand what was happening at the cervical ICA, and that information shaped the decisions we made during the intervention.

Conclusion

This case poses a special challenge for treatment, since in addition to a tandem lesion, it is a case of a patient within 12 to 24 hours after the occurrence of deficit. We have shown that contemporary, advanced diagnostics is an important prerequisite for the selection of further therapy and therefore the success of treatment. In our patient, the proximal-to-distal approach with initial proximal aspiration facilitated successful recanalization by enabling differentiation between atherosclerotic disease and

arterial dissection before carotid stenting. Although the optimal strategy for tandem occlusions remains individualized, this approach proved feasible and effective in the present case.

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References

1. Prabhakaran S, Gonzalez NR, Zachrisson KS, Adeoye O, Alexandrov AW, Ansari SA, et al. 2026 Guideline for the Early Management of Patients With Acute Ischemic Stroke: A Guideline From the American Heart Association/American Stroke Association. Epub ahead of print. Stroke 2026.
2. Albers GW, Marks MP, Kemp S, Christensen S, Tsai JP, Ortega-Gutierrez S, et al. Thrombectomy for Stroke at 6 to 16 Hours with Selection by Perfusion Imaging. N Engl J Med 2018;378(8):708–18.
3. Nogueira RG, Jadhav AP, Haussen DC, Bonafe A, Budzik RF, Bhuva P, et al. Thrombectomy 6 to 24 Hours after Stroke with a Mismatch between Deficit and Infarct. N Engl J Med 2018;378(1):11–21.
4. Sarraj A, Pujara DK, Campbell BC. Current State of Evidence for Neuroimaging Paradigms in Management of Acute Ischemic Stroke. Ann Neurol 2024;95(6):1017–34.
5. Thomalla G, Simonsen CZ, Boutitie F, Andersen G, Berthezene Y, Cheng B, et al. MRI-Guided Thrombolysis for Stroke with Unknown Time of Onset. N Engl J Med 2018;379(7):611–22.
6. Di Donna A, Muto G, Giordano F, Muto M, Guarnieri G, Servillo G, et al. Diagnosis and management of tandem occlusion in acute ischemic stroke. Eur J Radiol Open 2023;11:100513.
7. Eker OF, Panni P, Dargazanli C, Marnat G, Arquizan C, Machi P, et al. Anterior Circulation Acute Ischemic Stroke Associated with Atherosclerotic Lesions of the Cervical ICA: A Nosologic Entity Apart. AJNR Am J Neuroradiol 2017;38(11):2138–45.
8. Assis Z, Menon BK, Goyal M, Demchuk AM, Shankar J, Rempel JL, et al. Acute ischemic stroke with tandem lesions: technical endovascular management and clinical outcomes from the ESCAPE trial. J Neurointerv Surg 2018;10(5):429–33.
9. Galecio-Castillo M, Abraham M, Farooqui M, Hassan AE, Divani AA, Jumaa MA, et al. Endovascular treatment of acute ischemic stroke patients with tandem lesions: antegrade versus retrograde approach. J Neurosurg 2024;140(6):1726–35.

10. Spiotta AM, Lena J, Vargas J, Hawk H, Turner RD, Chaudry MI, et al. Proximal to distal approach in the treatment of tandem occlusions causing an acute stroke. *J Neurointerv Surg* 2015;7(3):164–9.
11. Marnat G, Bühlmann M, Eker OF, Gralla J, Machi P, Fischer U, et al. Multicentric Experience in Distal-to-Proximal Revascularization of Tandem Occlusion Stroke Related to Internal Carotid Artery Dissection. *AJNR Am J Neuroradiol* 2018;39(6):1093–9.
12. Diana F, Abdalkader M, Behme D, Li W, Maurer CJ, Pop R, et al. Antithrombotic regimen in emergent carotid stenting for acute ischemic stroke due to tandem occlusion: a meta-analysis of aggregate data. *J Neurointerv Surg* 2024;16(3):243–7.
13. Schirmer CM, Bulsara KR, Al-Mufti F, Haranhalli N, Thibault L, Hetts SW, et al. Antiplatelets and antithrombotics in neurointerventional procedures: Guideline update. *J Neurointerv Surg* 2023;15(11):1155–62.
14. Min X, Du J, Bai X, Wei T, Dmytriw AA, Patel AB, et al. Antegrade or Retrograde Approach for the Management of Tandem Occlusions in Acute Ischemic Stroke: A Systematic Review and Meta-Analysis. *Front Neurol* 2022;12:757665.
15. Albers GW. Late Window Paradox. *Stroke* 2018;49(3):768–71.
16. Rangel-Castilla L, Rajah GB, Shakir HJ, Shallwani H, Gandhi S, Davies JM, et al. Management of acute ischemic stroke due to tandem occlusion: should endovascular recanalization of the extracranial or intracranial occlusive lesion be done first? *Neurosurg Focus* 2017;42(4):E16.